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# Climate Changes and Mango Production (Temperature)

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## Article Information

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## Abstract

The mango, known as the {king of fruits}, is commercially significant in many parts of the world. In addition to offering a delicious tropical flavor, mangoes are a great source of nourishment and can make eating a satisfying and healthy sensory experience. Even though mango farming is known to exist in more than 120 nations, just 15 of them are responsible for more than 1% of the world's supply. More than 60% of the mangoes produced worldwide are grown in India, China, Thailand, Indonesia and Mexico.

The effects of climate change on agriculture must take into account the increasing $CO_2$ concentration, a significant contributor to climate change, as $CO_2$ is essential to critical plant functions, including photosynthesis. The fluctuation of temperature represents another climatic factor that affects mango productivity. The primary challenge facing the mango industry is irregular cultivation. The mango flowering was negatively impacted by the erratic distribution of cold nights and relatively warm winters. Mango output is already being impacted by rising average maximum temperatures. Therefore, regardless of mango growers, geniuses, or consumers, rapid climate change should be a top priority. A benefit of selection and breeding operations to adapt to climatic change is the high genetic variety of mangoes.

## Introduction

The mango (*Mangifera indica* L.) is the most popular among tropical fruits and is considered one of the oldest fruit trees cultivated in the world. It is known to be one of the best fruits in the global market and there is no difference in opinion about the fruits of Mango is considered the "king of fruit" because of its captivating flavor, excellent taste, attractive fragrance, irresistible sweetness, and beautiful shades of color both inside and outside the fruits.

Due to fluctuations in climate conditions, particularly rising temperatures, increasing $CO_2$ levels in the atmosphere, and warm nights during winter, there are various effects on various fruit crops [1]. In the near future, agriculture as a whole and mango production, in particular, will face serious threats from climate change. Given that atmospheric $CO_2$ is a significant contributor to climate change and is essential to fundamental plant functions like photosynthesis, the effects of climate change on agriculture must be taken into account. Due to its economic and nutritional benefits, the seasonal fruit known as the mango is one of the most extensively grown and consumed fruits in tropical and subtropical areas. Across a huge number of nations, including the Philippines, China, Pakistan, and Cambodia.

## Botany and distribution

Mango "*Mangifera indica* L.", belongs to the Anacardiaceae family. It was thought that the genus Mangifera originated in Myanmar, Thailand, Indo-China, and Malaya. The genus later migrated to other countries, including India. They claimed that the "Southeast Asia" region was home to the greatest diversity of the *Mangifera* genus. Additionally, as of recently, 69 species of this genus have been discovered globally [2]. Currently, it has grown to be a significant fruit crop in tropical & sub-tropical areas of the world [3].

## Effect of climate change on mango development

A negative impact of climate change will be felt in tropical regions with high temperatures in the past. Mango is a heat-tolerant crop, but it does best in humid, semiarid subtropics and monsoonal tropics. If excessive heat, drought, or evaporative demands are present, however, this crop's potential production capacity will be diminished. A seasonal fruit crop like the mango will react to temperature variations differently than an annual crop would [4]. Mangoes are a perennial crop that can withstand extreme dryness, and this ability can greatly increase productivity in successive growing seasons. The ability to survive is basically irrelevant in an annual crop farm where a stress-induced delay in production will result in a total loss of yield [5].

Mango can survive in a wide range of temperatures from 0 °C to 48 °C without experiencing any negative consequences. But if the plant is left at a low temperature for more than six hours, it will perish. In general, most kinds can withstand temperatures as low as 1 °C - 2 °C as long as they are not actively developing when the cold weather strikes and the period of time lasts no more than a few hours. Young trees in active growth suffer significant damage at zero degrees. At temperatures below 17 °C, pollen granules swell and lose viability. The prevaculate stage of meiosis during micro-sporogenesis is often more susceptible to temperatures below 10 °C. However, if exposed to low temperatures for longer than six hours, the plant can die. Most cultivars can typically endure temperatures of 1-2 °C as long as they are not actively growing when the cold weather hits and the period of time lasts no longer than a few hours. At 0 °C, young trees with vigorous development suffer severe damage [6].

Mango growth, development, and flowering are all greatly influenced by temperature, which is best between 27 °C and 33 °C. Mango is sensitive to the cold. Temperatures below 0.5 °C may cause the death of young trees, although mature trees may likely survive a few degrees of frost damage. Pollen is harmed by temperatures below 10 °C and over " 33 °C," which is one potential cause of the low fruit set seen in several commercial types of subtropical origin. Sensation, Edward, Isis, Fascell, and Keitt are several cultivars that are less tolerant of high temperatures and low humidity, and their fruits will display signs of sunburn. Some cultivars with high tolerance levels are Neldica, Tommy Atkins, Irwin, Lilley, Lippens, Chené, Kent, Ceriese, Kensington, Jubilee, Palmer, and Zillate. An essential component of the flowering induction process is the temperature differential between day and night. High overnight temperatures of 28 °C to 32 °C make the fruit sweet and mature well, while hot days and cool nights of 12 °C to 20 °C aid in the fruit's development of a more appealing hue [7].

Pollen grains that are uncommon and nonviable are produced at low temperatures < 17 °C. When microsporogenesis occurs, the prevaculate stage of meiosis appears to be most sensitive to temperatures below 10 °C. Germination and pollen tube growth are negatively impacted by cool temperatures as well; both processes are completely impeded at temperatures below 15 °C [8].

## Temperature degrees influencing blooming

The first annual occasion of mango blossoming occurs in Australia, which is considered the first annual occasion for mango flowering in all mango-producing regions worldwide. This growth cycle encourages the production of organic compounds and decides to plan the production of the other organic compounds.

The component that triggers blossoming is the beginning of cooler dry season temperatures. This happens from April onwards and blossoming can happen whenever between April and August, contingent on the area, cultivar, and yearly climate fluctuation. A comprehension of the drivers and parts that add to blooming in mango is basic to estimating its weakness to environmental change. The appearance of cold temperatures in other creation districts is related to winter and is frequently joined by winter downpours [9]. Regions in the semi-arid or desert climate zones may experience temperatures below 12 °C during winter, which can be detrimental to floral induction and development [10]. Similarly, rainfall during flower and fruit development can increase the incidence of disease.

In other regions, mangoes experience a longer period of dormancy, up to five months, where no growth occurs. This delays flowering until the beginning of spring when conditions become more favorable for growth.

Low temperatures can cause flower deformation, although Schaffer, et al. (1994) observed that panicle growth

occurs at 12.5 °C when no vegetative shoots are generated. When analyzing the chilly temperature requirements for blooming in several mango cultivars, Robbertse & Manyaga [11] discovered that the Keitt Mango cv. only needed 35 days below 15 °C, whilst the Heidi cv. could not be stimulated to flower for 45 days below 15 °C. When trees were kept at 15/5 °C (day/night), Sukhvibul, et al. [12,13] reported that the inflorescence development did not advance. Compared to trees growing at 25/15 °C (23 days) and 30/20 °C (16.1 days), temperatures of 20/10 °C (day/night) postponed the beginning of anthesis by 42.4 days. At a temperature of 20/10 °C (day/night), the delay in anthesis beginning was the greatest for "Sensation" cv. (55.5 d) and the least for "Nam Dok Mai" cv. (25.5d), while at other temperatures there was little difference between cultivars. Temperature also had an inverse effect on the total number of flowers per inflorescence. Change & Chao [14] found that during the flowering period, air temperature below 5 °C resulted in flower drop.

## Impact of climatic variables on fruit development and quality

Phases of blossoming and fruiting are significant in crops that are controlled by environmental conditions. Change environment factors intrude on the blossoming design of organic product sets and fertilization in many natural product crops through a decline in pollinator action and dust suitability. Downpours through the blossoming stage wash out the dust from the shame of bloom caused by less or no natural product set [15]. Mango creation misfortune 80% - 90% was accounted for in Gujarat due to unseasonal downpours followed by weighty dew assault during a blooming season which diminished organic product setting, expanded organic product drop at the pea stage, and expanded weighty rate of dingy moulid and fine buildup in mango [16]. Parmar, et al. [17] reported that the yield of mangoes was drastically reducing because warm nights that were recorded during the flower induction period in December seemed to have a detrimental effect leading to poor flowering and ultimately affecting the crop yield in mangoes.

Higher temperatures will decidedly affect the development of mango, which will be quicker in development. In Australia, the assessed development time frame for mangoes has diminished by 12-16 days (7% - 8%) because of a warming of the colder time of year season by 1.5 °C throughout recent years [18]. Higher temperatures can likewise emphatically affect organic product quality because of the pressure-initiated amalgamation of optional mixtures, some of which are of high dietary benefit (Figure 1). Higher light power further develops the complexion of hued cultivars [19]. Since serious light can be a stressor, a higher temperature can further develop natural product quality. It can likewise decidedly affect natural product size while further developing photosynthesis [20].

Cool temperatures are primarily liable for mango tree flower acceptance. Therefore, increasing temperatures will impede flower enlistment. Nonetheless, in regions where temperatures are explicitly cool through blooming, developing temperatures will further develop dust practicality and natural product set. Furthermore, temperature affects inflorescence size [21], and the quantity of blossoms per inflorescence [12]. Botanical enlistment likewise needs the openness of mature passes on to the light, and more significant levels of light power could decidedly affect mango blossoming.

In Egypt, the problem with setting fruits was not because of the early flowering time, but because of the climatic changes to which the mango flowering was exposed. In March, the daytime temperatures were suitable for flowers to complete the knot, then the trees were exposed to a sudden rise in temperature that led to the spoilage of a large proportion of pollen grains, and consequently, the drop in the fruit set rate and the death of a proportion of the embryos that had formed during the previous period, then the temperatures returned to improve during the day and some cold at the mid-night, and when the temperature at night drops below 12 °C, the cells do not divide and the fetus does not grow normally and atrophy Figure 2.


**Figure 1:** Image field of the effect of heat stress on mango trees (A and B).

**Figure 2:** Death or atrophy of embryo as a result of the fruits being exposed to fluctuations in temperature during fruit set.

## Conclusion

When climate change has consequences on the growth and productivity of mango trees in existing production regions, it is not possible to put a united scenario for this result due to area and seasonal volatility of future climate and is likely to be different responses to different cultivars. However, they often are negative and experience increasing mango cultivation under severe climatic conditions. We must be optimistic about the cultivation and production of mangoes in the future for several reasons. These species have great environmental plastic. Mango is adapted to difficult environments and has physiological mechanisms to deal with these different environments. The substantial diversity of genetic resources is a great advantage to transfer classic or modern breeding programs and choose to face climate change.

Finally, global climate change, such as high temperatures and drought, is well fit, up to a certain point, with environmental requirements for the growth and productivity of mango trees.

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